

Appendix 1: ASEAN Economic Integration and AFTA.

The ASEAN nations¹ came together with three main objectives: (1) to promote the economic, social and cultural development through cooperative programs; (2) to safeguard the political and economic stability of the region against big power rivalry; (3) and to serve as a forum for the resolution of intra-regional differences. Like APEC members, ASEAN countries are also very diverse. The total size of the population of ASEAN in 2001 comes up to 520 million. This represents a potential market, especially given the rising purchasing power in the region due to robust economic growth and per capita income growth in most of the ASEAN countries before and after financial crisis (1997). ASEAN's global trade achieved US\$ 607 billion in 1999 (ASEAN website: <http://www.aseansec.org.sg>).

In the years prior to 1992, there were a number of fundamental changes in the global and regional economic environment, which stimulated ASEAN countries to strengthen economic integration. These include (i) the emergence and consolidation of economic blocs in Europe and North America; (ii) within Southeast Asian region, the

¹ The Association of South East Asian Nations (ASEAN) was established on 8 August 1967 in Bangkok, Thailand. The original five member countries namely - Indonesia, Malaysia, Philippines, Singapore and Thailand signed the Bangkok Declaration. Then Brunei Darussalam joined the Association on 8 January 1984. Vietnam became the seventh member of ASEAN on 28 July 1995. Laos and Myanmar were admitted into ASEAN on 23 July 1997. Cambodia became the tenth members of ASEAN in April 1999.

The Bangkok Declaration united the ASEAN Member Countries to promote economic integration and improve the welfare of the people in the region. The Bangkok Declaration also set out guidelines for ASEAN's activities and defined the aims of the organization.

adoption of trade/economic liberalization policies since the mid-1980s on growth strategies based on attracting FDI; and (iii) the more favorable perception of the regional governments and the private sectors in the need for forging deeper economic cooperation in the light of greater competitive pressures coming from outside the region.

To sustain its rapid economic growth and development into the decade of the 1990s, ASEAN has to respond to the external challenges by maintaining strong economic relations with its major trading partners, thereby ensuring its markets access to the US, Japan and EU. ASEAN as a whole and for its constituent member countries also has to sustain international competitiveness in term of attracting the flows of FDI and to maintain production costs and other advantages. However, unlike EU, intra-ASEAN trade had only accounted for less than 20% of total ASEAN trade with the world. This is in contrast of most other serious groupings because: (i) lack of commitments to true economic integration have been cited; (ii) there was a greater degree of economic complementarities between ASEAN economies and the industrial and newly industrialized economies, than between themselves; (iii) the development levels in ASEAN differed widely.

Therefore, ASEAN viability would be desirable if ASEAN is able to succeed in the concrete sphere of intra-ASEAN economic integration. As a consequence, ASEAN officials finally launched upon the challenge of forming a free trade area known as the ASEAN Free Trade Area (AFTA) in the 4th ASEAN Summit in January 1992 in Singapore. All ASEAN countries have agreed to endorse AFTA², which is to be formed

² There are three short documents issued by the Fourth ASEAN Summit for creation AFTA: (i) Singapore Declaration of 1992; (ii) Framework Agreement on Enhancing ASEAN Economic Cooperation; and (iii) the Common Effective Preferential Tariff (CEPT) Scheme.

completely within 15 years, starting in January 1993. In 1993, ASEAN countries implemented their first wave of tariff reductions under the Common Effective Preferential Tariff (CEPT) scheme, which is the instrument to achieve AFTA. CEPT Scheme covers manufactured products, processed and unprocessed agriculture products. Though the process has commenced, various ASEAN Leaders remained convinced of an urgent need to accelerate the AFTA process so that the goal of achieving a unified ASEAN market could be attained earlier within 10 years instead of 15 years as originally scheduled³. It means that by keeping 1993 as the starting year, the AFTA shall be created by 1 January 2003 (Haflah Piei and Tan Tiang Chye, 1999; Seih Lee Mei Ling, 2000: 57-99):

AFTA's creation will help member-country to manage trade reforms more effectively to meet the WTO initiatives collectively. The rationale behind AFTA is not simply to promote an increase in intra-regional trade and investment, thereby leading to a greater degree of market integration⁴. Ultimately, this will increase the region's attractiveness for trade and foreign investment. It will give rise to increasing ASEAN

³ It was against this background that at the 26th Meeting of the ASEAN Economic Ministers (AEM) in Chiangmai, Thailand from September 22-23, 1994, ASEAN agreed to accelerate the actualization of CEPT for AFTA by shortening the time-frame to 10 years instead of 15 years as originally scheduled. At the same time, in order to support work on the smooth implementation of CEPT for AFTA, the 26th AEM agreed to establish an AFTA Unit in the ASEAN Secretariat and National AFTA Unit in the respective countries.

⁴ At the Fourth ASEAN informal Summit, the ASEAN Leaders agreed on the Initiative for ASEAN Integration (IAI). This called for narrowing the development gap between the older and newer members of ASEAN and enhancing the new members' integration with the rest of ASEAN. Then, on 23 July 2001, at the 34th ASEAN Ministerial Meeting, ASEAN Foreign Ministers adopted the Hanoi Declaration on Narrowing the Development Gap for Closer ASEAN Integration. The Declaration prioritized four areas namely Infrastructure, HRD, ICT and Regional Economic Integration. An IAI Unit was decided to establish in the ASEAN Secretariat to monitor mechanism for the implementation of the IAI Action Plan.

competitive edge as a production base geared for the world market. The critical step in trade promotion within the region is liberalization through the elimination of intra-regional tariffs and the limitation of non-tariff barriers. ASEAN's approach to liberalization is one kind of "open regionalism". This may be characterized as the promotion of the regional trade expansion through facilitation and the reduction in the official barriers to regional trade through multilateral reductions in protection, or simply put it is regionalism with global orientation (Haflah Piei & Abu Bakar, 1998).

Apart from promoting and enhancing trade, in order to enhance the attractiveness and competitiveness of the region for FDI, the AFTA framework also endeavours to promote greater intra-ASEAN investment and FDI in the region with arrangement to establish an ASEAN Investment Area (AIA)⁵, which should be realized by 2010. The AIA, which will facilitate investment into the region, will cover aspects relating to investment promotion, facilitation and liberalization. It had been agreed that member countries would undertake a coordinated effort in promoting ASEAN as regional investment location, emphasizing the benefit to be gained by investors who take a regional approach in investing in the region. The AIA would aim at enabling the free flow of capital among ASEAN and facilitating access to technology and skilled workers and

⁵ The Fifth ASEAN Summit, held in December 1995 in Bangkok, called for the establishment of a regional investment arrangement. Then, pursuant to the instruction of the Fifth Summit, the ASEAN Economic Ministers' Meeting in Manila in November 1996 instructed the Senior Economic Officials to initiate substantive discussion on proposal to realize an ASEAN Investment Area (AIA). The details of AIA were finalized by the end of 1998. The Fourth Meeting of the AIA Council held in September 2001 in Hanoi agreed to accelerate the full realization of the AIA for non-ASEAN investors in the manufacturing, agriculture, forestry, fishery and mining sectors

professional in ASEAN, and would call for a larger ASEAN private sector role in matters relating to investment activities (Haflah Piei and Tan Tiang Chye, 1999).

Besides the CEPT, AFTA has also paid attention to a new initiative beyond the field of trade in goods aimed at developing a framework of integration in services and intellectual property to further stimulate economic growth in the region and enhance ASEAN's competitiveness in the sectors. This is in consistence with the objective of broadening the scope of ASEAN economic integration to complement AFTA. Simultaneously, in order to satisfy a need for ASEAN to exchange views on their industrialization policies to enable a more coordinated and concerted approach to the economic development of the region, the great importance to the industrial development to accelerate industrialization programs and to maintain the high economic growth of ASEAN member countries has been given priority.

Appendix 2: Asia Pacific Economic Cooperation (APEC)

The Asia-Pacific Economic Cooperation (APEC) was established in 1989 in response to growing interdependence among Asia-Pacific economies. APEC includes all the major economies of the region and the most dynamic, fastest growing economies in the world, consisting of Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Hong Kong China, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Republic of the Philippines, Singapore, Taiwan (Chinese Taipei), Thailand and the United States of America. Peru, The Russian Federation and Socialist Republic of Vietnam became the latest members of the APEC community at the 10th APEC Ministerial Meeting, held on 14-15 November 1998 in Kuala Lumpur, Malaysia.

APEC has been experiencing the most remarkable economic growth in the world. The real GDP growth of APEC has increased from 2.5% in 1990 to 3.7% in 1996. Despite the financial instability of 1997-1998, APEC remains one of the fastest growing regions in the world with the average GDP growth of 3.4%. It is a major contributor to global prosperity and stability. APEC economies had a combined GDP of over US\$ 17.1 trillion, accounting for 54.3% of the World GDP in 1997 and more than 50% of global trade in 1996. With respect to investment, the APEC region again witnessed a large inflow of FDI in 1996, with China and the US continuing to be major destination (APEC website: <http://www.apecsec.org.sg>).

Begun as an informal dialogue group, APEC has since become the primary regional vehicle for promoting open trade, investment and practical economic integration. Its goal is to advance Asia-Pacific economic dynamism and sense of community. In the initial years, APEC focused largely on exchanges of views and project-based initiatives.

The concerns were simply to build the Asia-Pacific community through achieving economic growth and equitable development; to advance the process of Asia-Pacific Economic Integration by trade & investment liberalization and facilitation; and to promote a positive conclusion to the Uruguay Round of GATT negotiations.

It is widely believed that APEC is an innovative and flexible form of cooperation designed to accommodate the diversity of the economies on the Pacific Rim. These economies differ remarkably in term of the size as well as the density of their populations, incomes, cost structures and natural endowments. This diversity provides enormous potential for mutually beneficial trade and international investment. Rapidly falling real costs of transport and telecommunications are daily creating new commercial opportunities to take advantage of the natural complementarities among the regional economies.

Concomitantly, the diversity of economic background and level of technological capacity, forms of government can make integration difficult. The challenge for the APEC process, as regional governments have begun to implement the Bogor Declaration's goal of free and open trade and investment, is to find a workable compromise between different approaches to economic integration. Preserving the conditions needed for sustaining the positive trends of rapid growth and mutually beneficial integration of the region's economies is necessary (Sieh Lee Mei Ling, 2000: 100-1).

Foremost among these necessary conditions is to preserve the rule-based multilateral system for managing international trade and investment, based on the GATT/WTO. This multilateral system founded on the guiding principle of avoiding discrimination among trading partners, has been vital for the success of Japan, followed by others in Northeast and then some in Southeast Asia, to achieved unprecedented

improvements in their prosperity through all export-oriented economic strategy. The second important condition for promoting regional integration is to continue to dismantle many remaining impediments to international transactions among Asia Pacific economies. This is the essential intent of the Bogor Declaration, which endorsed the goal of free and open trade and investment in the region while reaffirming APEC's guiding principle of *open regionalism*, to facilitate international economic transactions in the region without seeking to divert trade or investment from the rest world (Drysdale & Vines, 2000).

Appendix 3: GATT/WTO

The idea of establishing an International Trade Organization (ITO) - alongside two Bretton Woods institutions (the World Bank and the IMF) - became reality on 30 October 1947. There was a view that the ITO should be established as a specialized agency of the United Nations, with comprehensive jurisdiction to provide not only the disciplines for global trade, but also rules relating to employment, commodities, restrictive business practices, investment and services. However, the effort to establish an ITO was finally abandoned when the US Congress refused to ratify the Havana Charter in 1950 (Kaul Nath Vijayendra, 1997; Das, 1998).

In the meantime, 23 of the 50 countries involved in deliberations on the ITO managed to finalize an interim agreement called the General Agreement on Tariffs and Trade (GATT). This Agreement, for the first time, sought to establish a multilateral rule based system for international trade in goods. It was annexed to the Final Act adopted at the conclusion of the Second Session of the Preparatory Committee of the UN Conference on Trade and Employment. It was subsequently rectified, amended and modified, and finally brought into force among the 23 contracting parties on 1 January 1948 through a Protocol of Provisional Application. The GATT objective was to provide a secure and predictable international trading environment for economic operations and to establish a foundation for a continuing process of trade and investment liberalization.

On 15 April 1994, in Marrakesh, Morocco, 111 countries out of the 125, which participated in the negotiations, signed the Final Act embodying the results of the Uruguay Round (UR) of Multilateral Trade Negotiations finally completed in 15 December 1993. The UR is considered the most ambitious and complex negotiations ever

undertaken under the auspices of GATT. The UR had dragged on for seven-and-a-half years, since the Round inception in Punta del Este, Uruguay, in September 1986. It has produced far-reaching changes in international trade and investment regimes (Kaul Nath Vijayendra, 1997; Haflah Piei & Shukri Noor, 1998).

Since 1 January 1995, a new international organization, the WTO has come into being, replacing GATT. The WTO has traversed a steady, but stormy path, and has, in some respects, returned to the nature of its birth, taking on some characteristics intended for the aborted International Trade Organization (ITO). The successful conclusion of the UR and the establishment of the WTO have ushered in a new era of global cooperation based on the basic principles of GATT, namely non-discrimination, transparency, progressive liberalization on the basis of reciprocity and protection through tariffs, not quantitative restrictions⁶.

The set of agreements establishing the WTO provides the institutional basis for a new regime. These agreements seek to define the scope, functions and structure of the WTO besides elaborating its relations with other organizations. The provisional nature of

⁶ The key principles of the GATT regime were:

- Trade without discrimination among members embodied in the most favoured nation clause (MFN) - Article I.
- Protection for domestic industries to be given through tariffs, and not through other commercial measures like quantitative restrictions - Article XI.
- A stable basis for trade that was partly attempted through the mechanism of “binding” tariff levels negotiated among contracting parties (Article II) and partly by ensuring transparency in the computation and application of tariffs.
- Promotion of fair trade and competition reflected in disciplines on subsidies and against dumping - Articles XVI and VI respectively.

the old GATT system ended. The Protocol of Provisional Application has been repealed. The jurisdiction of the new WTO, apart from the traditional domain relating to the trade in goods, for the first time extends to other issues relating to trade in services, trade-related intellectual property, trade-related investment measures and trade policy review mechanism. Also, there are two important institutional measures included in these agreements: the charter for the WTO and a new set of dispute settlement procedures, both designed to assist in the effective implementation of substantive rules established in the agreements. Some 50 other portions of agreements address subjects as diverse as anti-dumping, subsidies, technical standards, customs valuation, textiles and agriculture.

Much of the world trade in agriculture had been virtually excluded from full scope application of GATT disciplines up to 1 January 1995, largely on account of waivers obtained by the US and because of "grandfathering" provisions. This has now been radically altered in the Agreement on Agriculture in the UR, which extends the GATT disciplines to agriculture. Similarly, prior to 1995, much of the world trade in textiles had been regulated by the Multi-Fiber Arrangement (MFA), which provided the basis for the quotas imposed on developing country exports of textiles and clothing by developed country importers. But, the MFA was finally superseded by the Textile Agreement of the UR (ACT) from 1st January 1995, which would dismantle the MFA over the next decade and integrate this sector into GATT/WTO (Das, 1998).

The WTO contributes to openness in several crucial ways. The WTO has four objectives: to set and enforce the rules for international trade, to provide a forum to negotiate and monitor trade liberalization, to improve policy transparency, and to resolve trade disputes. Apart from that, the WTO eliminates the remaining problems of GATT, and for the first time, provides a legal definition of consensus. The creation of the Trade

Policy Review Mechanism (TPRM) is considered one of the UR innovations for trade negotiation. Under this procedure, the trade policies of member countries are reviewed on a periodic basis. In the TPRM format, the government makes an initial presentation pertaining to the country's trade policies, thereby providing the basis for panel discussions by experts drawn from other member countries. The review is rounded off by a concluding report of the panel. This basic purpose is to provide information, explanation, and discussion of countries' trade policies, and to thereby increase transparency and understanding. Besides, it is also a useful means of giving public, but informal feedback to governments on issues that may be of concern to their trading partners (Jackson, 1995; Anderson, 2000; WTO website: <http://www.wto.org>, 2001).

On the issue of membership, the original membership of the WTO and accession procedures for new membership are defined in Articles XI and XII of the Agreement establishing the WTO. These provisions supersede existing GATT provisions. All countries that were members of the GATT before the establishment of the WTO had the right to become founder members of the WTO once they signed the Final Act and the WTO Agreement, and made initial commitments on trade in services. Any non-member country can apply for membership of the WTO at any time under Article XII. However, its accession shall be negotiated between WTO members and the applicant on terms and conditions agreed mutually, and in consonance with WTO agreements. Each such accession is, therefore, unique. The old GATT i.e. GATT-1947, has been replaced by GATT-1994 (amended GATT), i.e. WTO, by amending six articles and by repealing the Protocol of Provisional Application.

The GATT/WTO rules to govern international trade serve at least three purposes. First, they protect the welfare of small and weak nations against discriminatory trade

policy actions of large and powerful nations. WTO Article I (MFN) and III (national treatment) promise that all WTO members will be given the same conditions of access to a particular country's market as the most favoured member, and that foreign suppliers will be treated the same as domestic suppliers. These fairness rules are fundamental to instilling confidence in the world trading system.

Second, the value of agreeing not to raise trade barriers, and to instead bind them in a tariff schedule at specified ceiling levels is definitely huge. This rule is embodied in Article II, whereby WTO members are expected to only limit trade with tariffs, and are obligated to continue to provide market access never less favourable than as agreed to in their tariff schedules. Again, greater certainty, which this tariff-binding rule brings to the international trading system, adds to the preparedness of countries to become more interdependent and encourages business people to invest more.

Third, perhaps the most important contribution of multilateral rules disciplining trade policy is that they help governments ward off domestic interest groups seeking special favours. This comes about partly via Article II, which outlaws raising bound tariffs, as well as via numerous other articles aimed at ensuring that non-tariff measures are not used as substitutes for tariffs (Anderson, 2000).

As far as developing and least developed countries are concerned, the preamble to the WTO Agreement recognizes the need for positive efforts to ensure that developing countries secure a share in the growth of international trade commensurate with their economic development. This implies that the principle of special and differential treatment has been maintained, but that there is an element of greater reciprocity. Yet, least developed countries enjoy more favourable treatment than before (WTO, 1998).

Appendix 4: Indirect Trade Deflection

By establishing an FTA/CU, “indirect trade deflection” will arise, quite different from “direct trade deflection”. While the latter refers to third country products entering the domestic market via a partner country where external tariffs are low, the former relates to a country selling its products in a regional market and replacing its own products at home with cheaper imports from third country sources.

The problem of direct trade deflection can be avoided by instituting rules of origin. Thus, a home country can ensure that no third country goods enter its market through a partner country under a specific economic integration scheme by invoking the rule of origin. Such rules of origin, however, cannot prevent indirect trade deflection, since goods entering the home market would originate in the partner country.

The problem of indirect trade deflection is illustrated in Figure A.1. The diagram shows how it is possible for a member country to export all its output of X to another member country and meet its own demand by importing from lower-cost producers outside the bloc. OW is the product price of the rest of the world R, WM is the import tariff imposed in country B, and WN is the import tariff in country A. Country B in the diagram exports its high cost output to country A ($OT = RS$) and replaces it with cheaper imports at home, thereby gaining additional tariff revenue of $(WM \times OT)$, while country A loses its tariff revenue $(WN \times RS)$. The danger of such ‘indirect trade deflection, which can have serious distributional consequences, can only be minimized if country A would lower its external tariff as well (Ariff, 1992: 7-9).

Appendix 5: Three-gap Macro-economic Model

In order to analyze the relationships mentioned above, the basic equations of the 3-gap macro-economic model used are the following:

$$i = i_p + i_g \quad (1)$$

$$i_p = i_o + \alpha i_g + \beta u \quad (2)$$

$$i = i_o + (1 + \alpha) i_g + \beta u \quad (3)$$

$$s = s_p + s_g + \phi \quad (4)$$

$$s_p = \sigma_o + \sigma_1 u \quad (5)$$

$$s_g = z - j^* \quad (6)$$

$$z = z_o + z_1 u \quad (7)$$

$$\pi u = i_g - s_g \quad (8)$$

$$\phi = (m_r + m_k + m_o) - (x + j^* + \eta) - \Delta R \quad (9)$$

$$m_r = a_o + a_1 u + a_2 x \quad (10)$$

$$m_k = (1 - \theta) i \quad (11)$$

$$q = q_o + \kappa (t) i \quad (12)$$

Where:

- U: Capacity utilization
- i: Total investment
- i_p : Private investment
- i_g : Public investment
- i_o : Animal spirit parameter

- α : Parameter
- βu : Accelerator term
- s : Total savings
- s_p : Private savings
- s_g : Public savings
- ϕ : Foreign savings
- σ_o, σ_i : Parameter determined by income elasticity of savings rate
- z : Fiscal efforts
- z_o, z_1 : Parameters
- j^* : Total interest payments on foreign debt
- m : Merchandise import
- m_r : Raw material import
- m_k : Capital import
- m_o : Other imports such as medicine and consumer goods
- X : Export
- η : Net foreign capital flow
- ΔR : Changes in reserves and other unaccounted capital flows
- $\kappa(t)$: Inverse of the incremental capital-output ratio
- q_o : Effect of depreciation and the underlying growth prospects
- q : The rate of growth of capacity

An overall supply constraint is represented by the activity variable “capacity utilization”, which is represented in the model by the variable u and takes a maximum

value of 1. All the variables are measured as proportions to potential output, with the exception of the public sector borrowing requirement (PSBR), which is measured as a proportion of actual output.

In equation (1), total investment \mathbf{i} is the sum of private investment \mathbf{i}_p and public investment \mathbf{i}_g .

Equation (2) proposes that private investment is linearly determined through an “animal spirits” parameter \mathbf{i}_0 , as a complementary response to government investment through parameter α , and through the accelerator term βu .

Equation (3) is total investment, being the sum of equation (1) and (2).

Total savings \mathbf{s} broken into private \mathbf{s}_p , public \mathbf{s}_g and foreign ϕ is given in equation (4).

Equation (5) characterizes private savings behavior as function of activity, with parameters σ_0 and σ_1 being jointly determined by the income elasticity of the savings rate.

In equation (6), total government savings is defined as the fiscal effort \mathbf{z} less total interest payments μj^* on foreign debt with μ is the government share of these payments (which is basically set to 1 for the calibration). Fiscal effort \mathbf{z} is defined implicitly as revenues minus current expenditure excluding debt service on foreign debt.

Fiscal effort \mathbf{z} is specified as a linear function of the activity variable in equation (7) through parameters \mathbf{z}_0 and \mathbf{z}_1 .

Equation (8) expresses the identity that the public sector borrowing requirement (PSBR) as a proportion of potential output πu is equal to the amount by which government investment expenditure exceeds government savings.

Equation (9) expresses the balance of payments as foreign savings (equivalent to the current account deficit composed of imports m minus export x , foreign interest payments j^* , and net capital inflows η) minus changes in reserves and other unaccounted capital flows ΔR .

Imports are broken down into (a) raw material imports m_r , whose level depends on economic activity u and the level of export x in the equation (10), (b) capital import m_k , dependent on the proportion of investment $(1 - \theta)$ that must be imported (equation 11), (c) and other imports such as medicine and consumer goods m_o . The level of export is exogenous in the model and assumptions in this variable have to be made jointly with the availability of external finance, even though it affects demand for intermediate input through the parameter a_2 in equation (10).

Equation (12) relates the rate of investment i to the rate of growth of capacity q through a Harrod-Domar equation in which $\kappa(t)$ represents the inverse of the incremental capital-output ratio and q_0 represents both the effect of depreciation and the underlying growth prospects for the economy. While the values of the various elasticities in equations 1 - 11 might evolve based on success/failure in development, the evolution of κ in this type of model can represent the overall impact of transition. There are various indices that can be associated with transition, such as the private versus public sector provision of goods and the level of foreign trade as proportion of output. κ , of course, can also be related to development index. The relative proportion of output between agriculture and industry can be one index.

For the purposes of analysis, one can combine equation (1) to (5) with the condition: $i = s$

and solve for the level of investment to derive the domestic savings gap:

$$i_s = (\sigma_o + z_o - j^* + \phi) + (\sigma_l + z_l)u \quad (11)$$

The fiscal gap is derived from equation (2) and (6) through (8):

$$i_f = i_o + (1 + \alpha)(z_o - j^*) + [(1 + \alpha)(\pi + z_l) + \beta] u \quad (12)$$

and the foreign exchange gap comes from equation (2), and (9) through (12):

$$i_e = \left[\frac{\phi - a_o - m_o + \eta + \Delta R + j^* + (1 - a_2)x}{1 - \theta} \right] + \left[\frac{a_l}{1 - \theta} \right] u \quad (13)$$

Appendix 6: Set of Equations In The VEM Model

PRODUCTION BLOCK

1. For output $Q(i)$ of sector i

$$Q(i) = \varphi_{p1}(i) \left\{ \sum_l \delta_{p1}(i,l) [INP(i,l)]^{\frac{\sigma_{p1}(i)-1}{\sigma_{p1}(i)}} \right\}^{\frac{\sigma_{p1}(i)}{\sigma_{p1}(i)-1}} \quad (1)$$

Where: $\varphi_{p1}(i)$ - scale parameter,

$\delta_{p1}(i,l)$ - share parameter

$INP(i,1) = D_F(i)$: composite factor demand by sector i ,

$INP(i,2) = D_V(i)$: composite goods input demand by sector i .

2. At the second nesting level for intermediate inputs:

$$D_F(i) = \left\{ \sum_f \delta_{p2}(i,f) [D_F(i,f)]^{\frac{\sigma_{p1}(i,1)-1}{\sigma_{p1}(i,1)}} \right\}^{\frac{\sigma_{p1}(i,1)}{\sigma_{p1}(i,1)-1}} \quad (2)$$

$$D_V(i) = \left\{ \sum_{k,s} \delta_{p2}(i,k) [D_V(k,i)]^{\frac{\sigma_{p1}(i,2)-1}{\sigma_{p1}(i,2)}} \right\}^{\frac{\sigma_{p1}(i,2)}{\sigma_{p1}(i,2)-1}} \quad (3)$$

Where: $\delta_{p2}(i,f)$ and $\delta_{p2}(i,k)$ -share parameter for factors and for goods respectively,

$\sigma_{p2}(i,1)$ and $\sigma_{p2}(i,2)$ -elasticity of substitution for factors and for goods respectively;

$D_F(i,f)$ - demand of factor f by sector i , and

$D_V(k,s,i)$ - demand of intermediate good k by sector i from source s .

3. The first order condition of cost minimisation to determine $D_F(i,f)$ and $D_V(k,s,i)$ are in the Generalized Algebraic Modelling System (GAMS) code.

$$D_F(i,f) = D_F(i,1) \times \left\{ \delta_{p2}(i,f) + \left(\sum_{f'} \delta_{p2}(i,f') - \delta_{p2}(i,f) \right) \times \left[\frac{\delta_{p2}(i,f) \times \left(\sum_{f'} PF(i,f') - PF(i,f) \right)}{\left(\sum_{f'} \delta_{p2}(i,f') - \delta_{p2}(i,f) \right) \times PF(i,f)} \right]^{1-\sigma_{p2}(i,1)} \right\}^{\frac{\sigma_{p2}(i,1)}{1-\sigma_{p2}(i,1)}} \quad (4)$$

Where: $D_F(i, 1)$: Composite factor input by sector i
 $\phi p_1(i)$: Scale parameter in production function
 $\sigma_{p2}(i, 1)$: Elasticity of substitution for factors (level 2)
 $\delta_{p2}(i, f)$: Share parameter for factor f by sector i
 $PF(i, f)$: Prices of factor f for sector i
 f, f' : Factor index

$$D_V(k, s, i) = D_V(i, 2) \times \left\{ \delta_{p2}(k, s, i) + \left(\sum_{k', s'} \delta_{p2}(k', s', i) - \delta_{p2}(k, s, i) \right) \times \frac{\sigma_{p2}(i, 2)}{1 - \sigma_{p2}(i, 2)} \right. \\ \left. \times \left[\frac{\left[\delta_{p2}(k, s, i) \times \left(\sum_{k', s'} PV(k', s') - PV(k, s) \right) \right]}{\left(\sum_{k', s'} \delta_{p2}(k', s', i) - \delta_{p2}(k, s, i) \right) \times PV(k, s)} \right]^{(1 - \sigma_{p2}(i, 2))} \right\} \quad (5)$$

Where: $D_V(i, 2)$: Composite intermediate input by sector i
 $\sigma_{p2}(i, 2)$: Elasticity of substitution for goods (level 2)
 $\delta_{p2}(k, s, i)$: Share parameter for goods by sources
 $PV(k, s)$: Price of intermediate inputs by sources
 k', k : Sector index
 s', s : Sources index

HOUSEHOLD CONSUMPTION BLOCK

1. Household utility function at the nest level 1:

$$U(j) = \left\{ \sum_i \delta_{U1}(j, i) C_C(j, i)^{\frac{\sigma_{C1}(j)-1}{\sigma_{C1}(j)}} \right\}^{\frac{\sigma_{C1}(j)}{\sigma_{C1}(j)-1}} \quad (6)$$

Where: $\delta_{U1}(j, i)$ & $\sigma_{C1}(j)$ - share parameter and elasticity of substitution
 $C_C(j, i)$ is consumption of composite good i by household j , which is determined by demand function:

$$C_c(j,i) = \frac{[\delta_{U1}(j,i)]^{\sigma_{C1}(j)} Y(j)}{[CP(j,i)]^{\sigma_{C1}(j)} \sum_k [\delta_{U1}(j,k)]^{\sigma_{C1}(j)} CP(j,k)^{1-\sigma_{C1}(j)}} \quad (7)$$

$Y(j)$ - income of household j ;

$CP(j,i)$ - composite price of good i by household j ;

2. Household consumption nest level 2 (CES function of domestically produced and imported consumer goods) $C(j,i,s)$:

$$C_c(j,i) = \left\{ \sum_s \delta_{C2}(j,i,s) C(j,i,s)^{\frac{\sigma_{C2}(j,i)-1}{\sigma_{C2}(j)}} \right\}^{\frac{\sigma_{C2}(j,i)}{\sigma_{C2}(j,i)-1}} \quad (8)$$

Where: $C(j,i,s)$ - good demand source:

$$C(j,i,s) = \frac{[\delta_{U2}(j,i,s)]^{\sigma_{C2}(j,i)} \left[Y(j) - \sum_{k \neq i} CP(j,k) C_c(j,k) \right]}{[P_C(i,s)]^{\sigma_{C2}(j,i)} \sum_{s'} [\delta_{U2}(j,i,s')]^{\sigma_{C2}(j,i)} P_C(i,s')^{1-\sigma_{C2}(j,i)}} \quad (9)$$

$P_C(i,s)$ - consumer price of good i from source s ;

$CP(j,i)$ - composite price of good i by household j is determined by formula:

$$CP(j,i) = \left\{ \sum_s [\delta_{U2}(j,i,s)]^{\sigma_{C2}(j,i)} [P_C(i,s)]^{1-\sigma_{C2}(j,i)} \right\}^{\frac{1}{1-\sigma_{C2}(j,i)}} \quad (10)$$

GOVERNMENT

1. Consumer price of domestically produced goods i

$$P_C(i,D) = P(i) \cdot [1 + t(i)] \quad (11)$$

Where: $P(i)$ is producer price of goods i ;

$t(i)$ is consumption tax rate for goods i

2. Consumer price of imported goods i

$$P_C(i,M) = PWM_C(i) \cdot [1 + t(i)] \cdot [1 + t_M(i,2)] \quad (12)$$

Where: $PWM_C(i)$ - the world price of imported consumer good i .

$t_M(i,2)$ is tariff rate for imported goods i .

3. Gross price for using factor (capital and labor use tax)

$$PW(i, f) = W(f) \cdot [1 + t_f(i, f)] \cdot [1 + t_c(i, f)] \quad (13)$$

Where: $W(f)$ is wage rate;

$t_f(i, f)$ is factor tax rate for using factor f by sector i ;

$t_c(i, f)$ is corporate tax as percentage of factor f used in sector i ;

4. Net foreign trade:

$$AID = \sum_i [M_c(i) + M_A(i)] - \sum_i E(i) \quad (14)$$

Where: $M_c(i)$ & $M_A(i)$ - total import of consumer goods and intermediate input good i
 $E(i)$ - total export of good i .

EQUILIBRIUM CONDITIONS

1. Zero profit condition:

$$Q(i)P(i) = \sum_f D_F(i, f)PW(i, f) + \sum_k D_V(k, i)CP_A(k) \quad (15)$$

$CP_A(k)$ is the composite price of intermediate input k , $i, k \in I$.

2. Equilibrium condition for traded goods markets:

$$Q(i) = \sum_{j, s \neq FR} C(j, i, s) + \sum_{k, s \neq FR} D_V(i, k, s) - E(i) \quad (16)$$

with two addition import balance for consumer goods $M_c(i)$ and intermediate input goods $M_A(i)$:

$$\begin{aligned} M_c(i) &= \sum_{j, s \neq DM} C(j, i, 2) \\ M_A(i) &= \sum_{k, s \neq DM} D_V(i, k, 2) \quad i \in I_T \end{aligned} \quad (17)$$

3. Equilibrium condition for non-traded goods markets:

$$Q(i) = \sum_j C(j, i, 1) + \sum_k D_V(i, k) \quad i \in I_N \quad (18)$$

4. Equilibrium condition for the factor market:

$$\sum_i D_F(i, f) = \sum_j END(j, f) \quad (19)$$

GLOSSARY OF NOTATIONS USED IN THE MODEL DESCRIPTION

INDEX SETS

$I = \{V1*V17\}$	index set for goods (sectors)
$I_N = \{V13\}$	index set for non-traded goods
$I_T = \{V1*V12, V14*V17\}$	index set for traded goods
$J = \{1, 2, \dots, 10\}$	index set for households
s	source or destination index
$s = 1$	"domestic": domestically produced or domestic sale
$s = 2$	"foreign": import or export
f	factor index
$f = 1$	capital
$f = 2$	labor
l	inputs
$l = 1$	factors
$l = 2$	goods

SUPPLY & DEMAND BLOC

$S(i, s)$	supply of good i to destination s , $i \in I_T, s = 1, 2$
$S_{NF}(i)$	net final supply of good i , $i \in I_T$
$Q(i)$	production of good i , $i \in I$
$D_F(i, f)$	demand of factor f by sector i , $i \in I, f = 1, 2$
$D_V(i, k)$	Intermediate inputs of good i used by sector k , $i, k \in I$
$D_V(k, s, i)$	Intermediate inputs of good i from source s used by sector k , $i, k \in I, s = 1, 2$
$D_F(i, 1)$	Composite factor input by sector i
$\varphi_{p1}(i, f)$	Scale parameter
$\sigma_{p2}(i, 1)$	Elasticity of substitution for factors (level 2)
$\delta_{p2}(i, f)$	Share parameter for factor f by sector i
$PF(i, f)$	Prices of factor f for sector i

f, f'	Factor index
$D_G(i, 2)$	Composite intermediate input by sector i
$\varphi_{p1}(k, s, i)$	Scale parameter
$\sigma_{p2}(i, 2)$	Elasticity of substitution for goods (level 2)
$\delta_{p2}(k, s, i)$	Share parameter for goods by sources
$PG(k, s)$	Price of intermediate inputs by sources
k', k	Sector index
s', s	Sources index
$U(j)$	utility function for household $j, j \in J$
$C(j, i, s)$	consumption of good i from source s by household $j, j \in J, i \in I, s = 1, 2$
$C_C(i, j)$	consumption of composite good i by household $j, j \in J, i \in I$
$M_C(i)$	import of consumer good $i, i \in I_T$
$M_A(i)$	import of intermediate of good $i, i \in I_T$
$E(i)$	export of good $i, i \in I_T$
$END(j, f)$	* endowment of factor f by household $j, f = 1, 2, j \in J$

PRICE BLOC

$P(i)$	producer price of good $i, i \in I$
$P_C(i, s)$	consumer price of good i from source $s, i \in I, s = 1, 2$
$CP(j, i)$	composite price of good i by household $j, i \in I, j \in J$
$PD(i)$	price of good i for domestic sale, $i \in I$
$PE(i)$	price of good i for foreign sale, $i \in I_T$
$PWE(i)$	* world price of exported good $i, i \in I_T$
$PWM_C(i)$	* world price of imported consumer good $i, i \in I_T$
$PWM_A(i)$	* world price of imported input good $i, i \in I_T$
$W(f)$	wage rate, $f = 1, 2$
$CP_A(i)$	composite price of intermediate inputs, $i \in I$
$P_A(i, s)$	price of intermediate input i by source $s, i \in I_T, s = 1, 2$
$PW(i, f)$	price of factor f used by sector i (gross of factor and corporate taxes)

INCOME AND REVENUE

R	government revenue
$Y(j)$	income of household $j, j \in J$
TY	household income tax revenue
TR	indirect tax revenue
CR	corporate tax revenue
IR	input tax revenue
MR	import tax revenue
$FR(f)$	factor use tax revenue by factors, $f = 1, 2$
TTR	total revenue from all taxes

TAX VARIABLES

$t_I(i)$	* tax rate for commodity input i , $i \in I$
$t_F(i,f)$	* factor tax rate for use of factor f by sector i , $i \in I$, $f = 1, 2$
$t_C(i,f)$	* corporate tax rate as percentage of factor f used in sector i , $i \in I$, $f = 1, 2$
$t_Y(j,f)$	* income tax rate for income from factor f of household j , $j \in J$, $f = 1, 2$
$t_M(i,s)$	tariff for good i from source s , $i \in I$, $s = 1, 2$
$t(i)$	* consumption tax rate for good i , $i \in I$
$t_E(i)$	export tax rate for good i , $i \in I_T$

OTHER VARIABLES

RMD	* ratio between imported intermediate goods and total intermediate goods
AID	* net foreign trade

Total number of single variables
in the Replication Code:

2663

PARAMETERS AND ELASTICITIES

$\sigma_{P1}(i)$	* elasticity of substitution in production nest level 1 for sector i , $i \in I$
$\sigma_{P2}(i,l)$	* elasticity of substitution in production nest level 2 for sector i , $i \in I$
$l = 1$	for factors
$l = 2$	for goods
$\sigma_{C1}(j)$	* elasticity of substitution in consumption nest level 1 for household j , $j \in J$
$\sigma_{C2}(j,i)$	* elasticity of substitution in consumption nest level 2 for household j and commodity i (substitution between domestically produced and imported products)
$\delta_{C2}(j,i,s)$	share parameter in household utility function nest level 2 (substitution between imported and domestically produced goods), $j \in J$, $i \in I$, $s = 1, 2$
$\delta_{C1}(j,i)$	share parameter in household utility function nest level 1, $j \in J$, $i \in I$, $s = 1, 2$
$\delta_{P1}(i,l)$	share parameter in production function nest level 1, $i \in I$, $l = 1, 2$
$\delta_{P2}(i,f)$	share parameter for factors in production function nest level 2, $i \in I$, $f = 1, 2$
$\delta_{P2}(i,k)$	share parameter for goods in production function nest level 2, $i \in I$, $k = 1, 2$
$\phi_{P1}(i)$	scale parameter in production function of sector i nest level 1, $i \in I$
$\phi_A(i,k)$	Armington function scale parameter, $i \in I_T$, $k \in I$

* Exogenous variable